FPGA Development Board

With a 300-Kgate Xilinx SpartanIIE device

By G. May DL3ABQ

In sharp contrast with plummeting prices of FPGA chips, suitable development systems for these interesting devices are costly and hard to find. However, that situation seems to have changed for the better with the arrival of a low-cost kit from Australia-based BurchEd.

The FPGA (Field Programmable Gate Array) is a programmable logic building block for use in complex digital circuits. Using either a hardware descriptive language or a graphics editor, users of FPGAs are able to design logic circuits that can be downloaded into an FPGA chip. The result (hopefully) is the FPGA acting as the desired logic configuration in all its complexity.

As may be expected, FPGAs contain a massive amount of universal elements consisting of gates and/or flip-flops, depending on the FPGA chip you have selected for the job. These elements may be interconnected to form configurations, hence the ability of an FPGA to perform countless digital functions designed by you, the user.

Most FPGAs are manufactured in SRAM (static random access memory) technology, and that is why they lose their configuration when the supply voltage disappears. To enable FPGAs to resume their normal task when the supply voltage returns, special configuration EPROMs are employed from which an FPGA can load a set of configuration data to enable it to carry out its programmed function. The **Xilinx PROM Programmer** described in the October 2003 issue of *Elektor Electronics* is just the ticket for this sort of functionality.

Sure, there are also non-volatile FPGAs (for instance, 'Antifuse' types), but these devices may only be programmed once. Leading manufacturers of FPGAs include Xilinx, Altera and Actel.

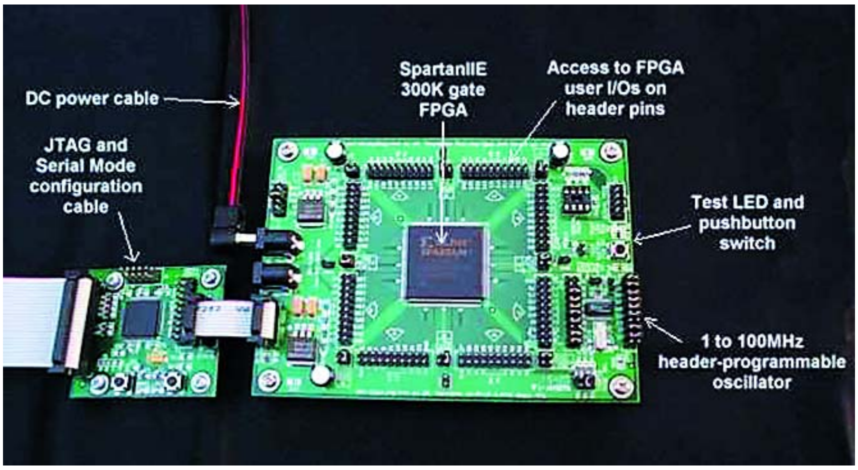

DC power cable
JTAG and Serial Mode configuration cable
SpartanIIE 300K gate FPGA
Access to FPGA user I/Os on header pins
Test LED and pushbutton switch
1 to 100MHz header-programmable oscillator

Figure 1. FPGA development board B5-X300 from Burched.

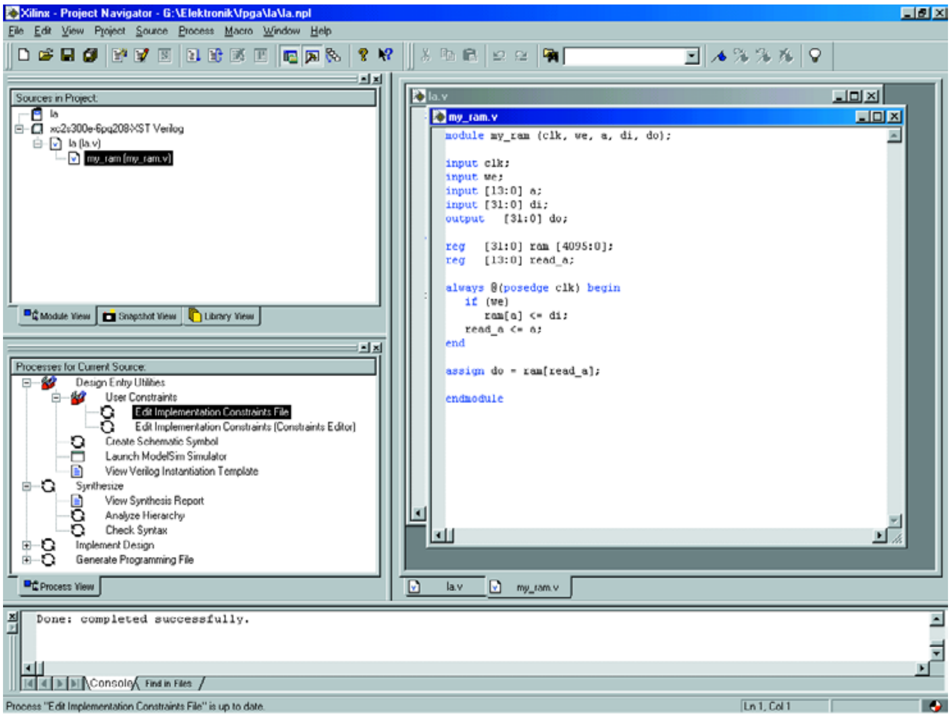
The CPLD (Complex programmable Logic Device) is another example of a programmable logic component. CPLDs contain several large logic structures not unlike those found in GALs (Generic Array Logic). It is therefore safe to say that a CPLD consists of an array of GALs. CPLDS generally employ non-volatile EEPROM cells for their programmable elements. The main players in the CPLD arena are Lattice, Xilinx and Altera.

Depending on the size of the FPGA or CPLD, entire processors or similarly complex functions may be realised using their incredibly versatile elements. In the industry, these devices are not only used to build prototypes (in a very short time), but also at the heart of so-called reconfigurable systems, a prominent application range being signal processing.

The performance of such a component is usually expressed in 'gate equivalents', describing the number of theoretically available gates deep inside the FPGA. These figures should be used with care, however, because for reasons of product marketing they tend to be on the optimistic side.

Typical sizes of CPLDs are 1,000 to 50,000 gate equivalents, or anything up from 10,0000 to a few million in the case of FPGAs.

Although smaller components have become available at relatively low cost, higher integration is still inevitably coupled to higher prices. To electronics designers, these new logic devices are an attractive alternative to using literally dozens of conventional logic ICs. Also, when the processing speed of a microcontroller is not sufficient for a certain application, programmable logic is a viable alternative.



```
module my_ram (clk, we, a, di, do);

input clk;
input we;
input [13:0] a;
input [31:0] di;
output   [31:0] do;

reg   [31:0] ram [4095:0];
reg   [13:0] read_a;

always @(posedge clk) begin
   if (we)
      ram[a] <= di;
   read_a <= a;
end

assign do = ram[read_a];

endmodule
```

```
Done: completed successfully.
```

Process "Edit Implementation Constraints File" is up to date.

Figure 2. Xilinx FGA programming software in action.

Development Board

The Australian manufacturer Burch Electronic Designs (BurchEd) [1] offers a cost effective development system for FPGAs (**Figure 1**). Burched's B5-X300 is based on a Xilinx FPGA from the SpartanIIE series sporting a massive 300,000 gate equivalents. The system come with a download adapter for direct and easy connection to the printer port (Centronics) on your PC. This interface serves to convey configuration data from the PC to the FPGA chip.

The board proper contains a clock oscillator whose output frequency is set using jumpers. Also on the board is a socket for the configuration EPROM and pinheaders for easy access to the FPGA pins.

Besides the FPGA board, modules are offered that could easily form part of an application circuit. The following modules are currently offered:

- switch board
- LED board
- 7-segment displays
- memory extension
- interconnection board for RS232, mouse, keyboard and VGA
- CompactFlash interface
- IDE interface
- Flash configuration board

The software development environment used with the BurchEd kit is Xilinx' **Webpack** freeware, which allows the component to be programmed in a number of different ways (see **Figure 2**). The software may be downloaded from the Xilinx website [2].

The BurchEd board is very simple to operate. In fact, the user guidelines found on the company's homepage should enable even inexperienced users of FPGAs to load his/her first program into the chip and make a LED flash on the board!

We are informed that BurchEd do not (yet) have a UK distributor so you have to contact them directly in Australia or via their French distributor, Hi Tech Tools [5]. The board costs AUS$ 330.00, US$ 215.00, £ 135.00 or € 195.00.

Application examples

Unlike any of its competitors in the UK electronics magazine market, *Elektor Electronics* has a claim to several published, tried and tested projects employing configurable logic devices like GALs and CPLDs. Burch Electronic Designs on their homepage [1] offer a number of example programs for free downloading. Useful as they are to get started with FPGA technology, the programs are rather scanty. However, according to Tony Burch they will be extended in the near future so have a look by the time you read this.

A particularly interesting theme in relation to FPGAs covers the development of one's own processors. A large collection of material with specific relevance to this fascinating subject may be found at [3].

Finally, as you may have noticed already, a growing number of electronics designers is busy migrating old arcade-style games (say, Pacman) from their antediluvian platforms onto FPGAs. A wonderful website on this subject may be found at [4] where full details on the implementation may be downloaded.

(030216-1)

Contact information

Burch Electronic Designs,
PO Box 1548, Macquarie Centre, North Ryde,
NSW 2113, Australia.
Tel: +61 2 9614 3358,
fax: +61 2 9614 3889.
Internet: www.BurchED.com

Internet addresses

[1] www.burched.biz
[2] www.xilinx.com/xlnx/xil_prodcat_landingpage.jsp?title=ISE+WebPack
[3] www.fpgacpu.org/
[4] www.fpgaarcade.com/
[5] http://www.hitechtools.com